Fishery Data Series No. 96-24

Escapement and Composition of Coho Salmon in the Nome and Niukluk Rivers in 1995

by
Tim Viavant

August 1996

Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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by

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August 1996

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-11, Job No. S-3-1(b)

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This document should be cited as:
Viavant, T. 1996. Escapement and composition of coho salmon in the Nome and Niukluk rivers in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-24, Anchorage.

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ABSTRACT

Coho salmon *Oncorhynchus kisutch* escapement in the Nome and Niukluk rivers was estimated from counting towers on each river. Coho salmon were also sampled opportunistically from the Niukluk River for age, sex, and length compositions throughout the run using rod and reel, from sport angler catches, subsistence catches, and from carcasses of spent fish. Total coho salmon escapement past the counting tower on the Nome River was estimated at 1,712 fish. The 95% confidence interval for the estimate of total escapement was from 1,361 fish to 2,063 fish. Total coho salmon escapement past the counting tower on the Niukluk River was estimated at 4,633 fish. The 95% confidence interval for the estimate of total escapement was from 4,091 fish to 5,175 fish.

Key words: tower counts, coho salmon *Oncorhynchus kisutch*, escapement, Nome River, Niukluk River.

INTRODUCTION

The Nome River flows from its headwaters on the eastern edge of the Kigluaik Mountains approximately 70 km to the south, entering Norton Sound approximately 5.6 km east of Nome (Figure 1). The Nome River is accessible from the Nome-Taylor highway which parallels much of its length. The Niukluk River is approximately 100 km in length and drains an area of the western Bendeleben Mountains between the drainages of the Kuzitrin and Fish rivers. It enters the Fish River at approximately 64° 48'N, 163° 28' W. The river is accessible by boat from a gravel bar boat launch site at Council about 145 km east of Nome.

The Nome and Niukluk rivers support some of the most important coho salmon *Oncorhynchus kisutch* sport fisheries on the Seward Peninsula. The Nome River has historically sustained more angler effort than any other stream on the Seward Peninsula, averaging just under 5,500 angler-days/year between 1988 and 1994 (Mills 1989-1994, Howe et al. 1995). Estimated coho salmon harvests from the Nome River between 1988 to 1994 ranged from 308 fish in 1994 to 1,291 fish in 1989, and averaged 707 fish during this time period (Table 1, Mills 1989-1994, Howe et al. 1995). Estimated angler effort on the Fish/Niukluk river system has averaged just over 2,500 angler-days annually between 1988 to 1994. The sport fish harvest from 1988 to 1994 in the Fish/Niukluk river system has ranged from 267 to 1,185 coho salmon with an average harvest of 833 fish (Mills 1989-1994, Howe et al. 1995).

Both the Nome and Niukluk rivers are used extensively for subsistence fishing for chum salmon *O. keta*, pink salmon *O. gorbuscha*, and coho salmon. In addition, coho salmon are harvested commercially in Norton Sound, both in targeted fisheries and incidentally.

Aerial counts of coho salmon escapement into the Nome River for the past five years have ranged from 267 in 1993 to 691 in 1992. A counting tower, first operated on the Nome River during 1993, provided a cumulative estimate of 4,349 coho salmon, but the tower ceased operation prior to the end of the coho salmon run. Prior to discontinuation of counting in 1994 due to high water, the tower count estimated 1,283 coho salmon in the river. Since almost 1,700 coho salmon had been counted by the same time the previous year, sport fishing was closed for the remainder of 1994 by emergency order.

Due to increasing angler effort on the Seward Peninsula in general and the large proportion of coho salmon harvest supported by these two rivers in the Nome area, a reliable coho salmon

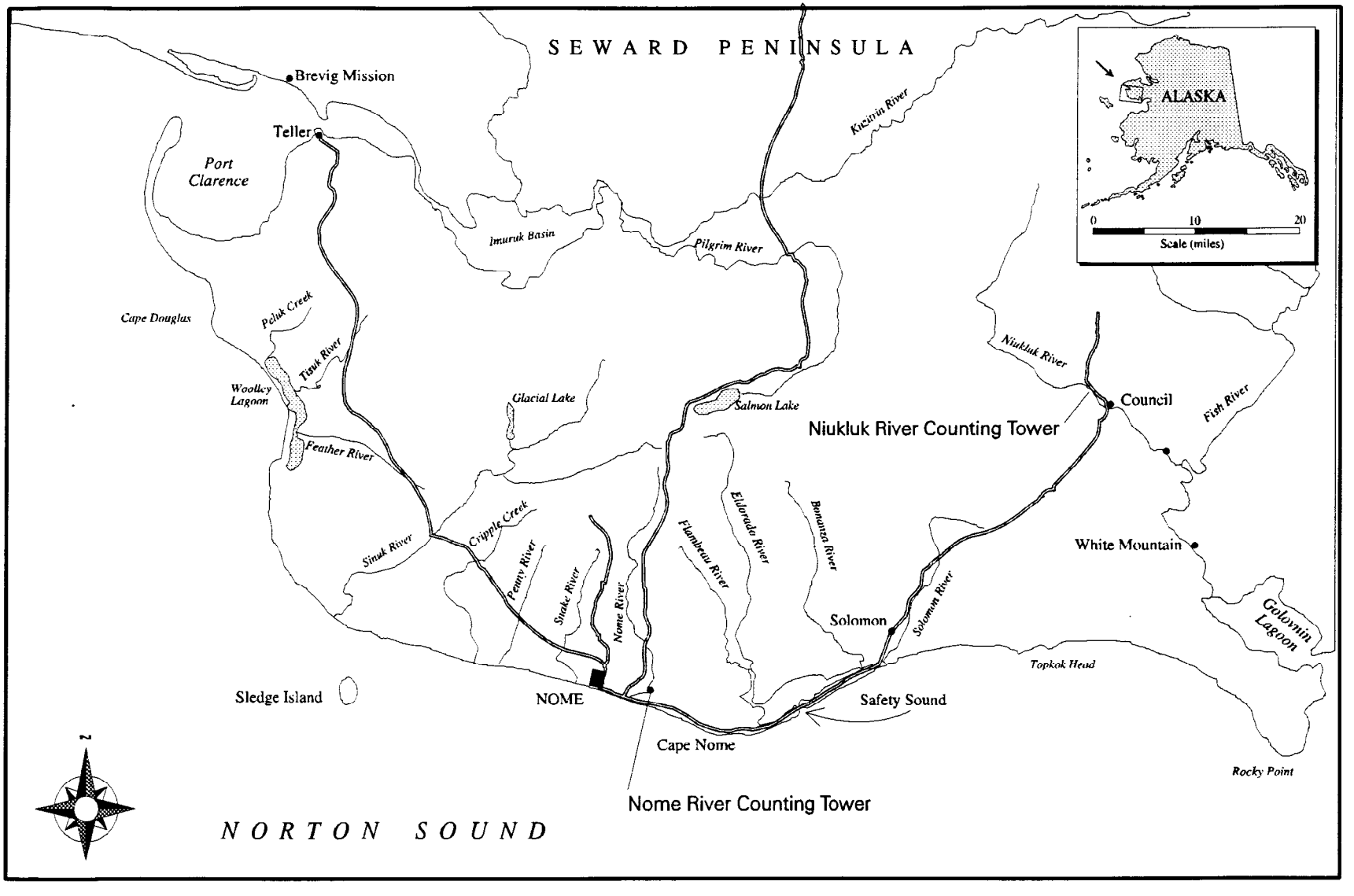

Figure 1.-Map of the Seward Peninsula showing the locations of the Nome and Niukluk rivers counting towers.

Table 1.-Estimated sport fishing effort and harvest for the Nome and Fish/Niukluk rivers, 1988 to 1994.

Year	Nome River			Fish/Niukluk River		
	Effort (Angler-days)	Total Harvest	Coho Harvest	Effort (Angler-days)	Total Harvest	Coho Harvest
1988	5,639	4,984	1,291	2,183	3,218	800
1989	6,569	8,994	1,233	1,992	2,620	728
1990	6,609	4,256	384	2,059	1,901	267
1991	4,609	2,468	417	2,470	4,744	977
1992	6,307	5,683	713	2,635	1,566	753
1993	3,562	2,335	602	3,589	3,533	1,185
1994	4,953	4,048	308	2,859	2,786	1,122

escapement estimate and better information on the run timing into these rivers are needed to provide data necessary for the sustained yield management of this resource.

The objectives of the coho salmon escapement project for the Niukluk and Nome rivers in 1995 were to:

1. estimate the escapement of coho salmon in the Nome and Niukluk rivers such that the estimates are within 10% of the actual value 95% of the time; and,
2. estimate the age, sex, and length compositions of the escapement of coho salmon in the Nome and Niukluk rivers such that all estimated proportions are within 10 percentage points of the actual proportions 95% of the time.

In addition to these objectives there were three tasks:

1. generate daily estimates of the number of coho salmon that pass the counting sites;
2. generate absolute and relative cumulative frequency distributions of daily counts of coho salmon past the counting sites; and,
3. conduct a boat count of coho salmon on the Solomon River.

METHODS AND MATERIALS

TOWER COUNTS

The total numbers of coho salmon returning to the Nome and Niukluk rivers were estimated by counting fish as they passed by counting towers. Tower operations (counting) were conducted starting June 22nd on both rivers and ending September 6 on the Nome River and September 13 on the Niukluk River. Most salmon spawning in these rivers occurs upstream of the tower locations. Light colored panels were placed across the portion of the channel nearest to the counting towers in each river, and a partial weir was used to channelize the movement of fish across the panels.

Lights were suspended across the channel to illuminate fish during hours of low ambient light. On the Niukluk River, lights were used beginning August 1. Initially, the lighting system was battery

powered, and lights were only turned on during 30 min counting periods in order to conserve batteries. Lights were initially only needed between 2:00 AM and 4:00 AM, so they were only used for two counting periods per day. Because salmon may avoid unusual substrate or artificially illuminated areas, lighting was switched to generator power on August 6, and from that point on, once artificial lighting was turned on, it was not shut off until the ambient light level was high enough to allow observation of fish without the aid of the artificial lighting. The lights were left on between the 30 minute counting periods because salmon may hold below the illuminated area and move upstream after the counting period if the lights were turned off. Lights used on the Nome River were run on generator power beginning August 1, and on the Nome River, once artificial lighting was turned on, it was not shut off until the ambient light level was high enough to allow observation of fish without the aid of the artificial lighting for the entire duration of counting. Counts were scheduled throughout the day to monitor 24-hr migration patterns.

These towers were initially placed on the Niukluk and Nome rivers to estimate the magnitude of the chum salmon escapement past the counting sites and were extended to count coho salmon escapement. Based on the timing of the 1994 Nome and Niukluk rivers tower counts, it appeared that most of the coho salmon runs into these rivers could be sampled by extending the operation of both towers through the second week of September. Since the chum and coho salmon runs overlap to some degree in late July and early August, observers were relied upon to differentiate between the two species as they passed towers during that time. This project was begun on August 1, 1995 in both rivers, at the beginning of the coho salmon run, after most of the chum salmon run was over, however, a few coho salmon were counted in late July on both rivers.

The Commercial Fisheries Management and Development Division provided operational funding for the Nome River and Niukluk River counting towers for the period beginning (with set-up) June 19 and ending July 31, primarily to determine chum and pink salmon escapement. Counting began on both rivers at noon on June 22, 1995. Through July 31, the crews counted six 30 min counts (every other half hour) in each of three 6 h shifts each day except for one day off per week and one day per week of half-hour counts for 24 hours. The first shift ran from 0000 hours to 0530 hours, the second ran from 1200 hours to 1730 hours and the third shift ran from 1800 hours to 2330 hours. Sundays were the normal day off. On the day following the day off, the crews counted 24 half-hour counts in three 8 h shifts.

Beginning August 1 the schedule changed to one that rotated among three possible 8 h daily shifts of 30 min counts. Shift I began at 0000 hours and ended at 0730 hours, Shift II began at 0800 hours and ended at 1530 hours, Shift III began at 1600 hours and ended at 2330 hours. A stratified systematic sampling design was used. The abundance estimates were stratified by shift and sampled systematically in the following manner: on day one of the study and every other day thereafter Shifts I and III were sampled. On day two of the study and all other even days only Shift II was sampled (Figure 2). With this schedule, 50% of all possible shifts were sampled and 50% of all counting periods within a shift were sampled. The shifts rotated according to the following schedule where the shaded areas indicate times counted.

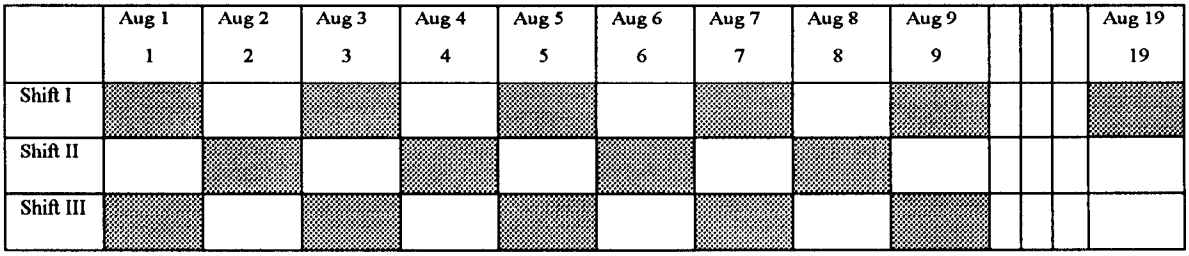

Figure 2.-Counting schedule for the Nome River and Niukluk River counting towers, August 1 to August 19, 1995.

By August 10 it became apparent that coho salmon moved primarily at night in pulses. Beginning August 19 at 0800 hours, the schedule was changed to increase the sampling effort during times of greatest passage. The new Shift I began at 0500 hours and ended at 1230 hours, Shift II began at 1300 hours and ended at 2030 hours, and Shift III began at 2100 hours and ended at 0430 the next day. For reporting purposes the day began at 2100 hours for this new schedule. The altered schedule (Figure 3) rotated shifts according to the following schedule where the shaded areas indicate times counted.

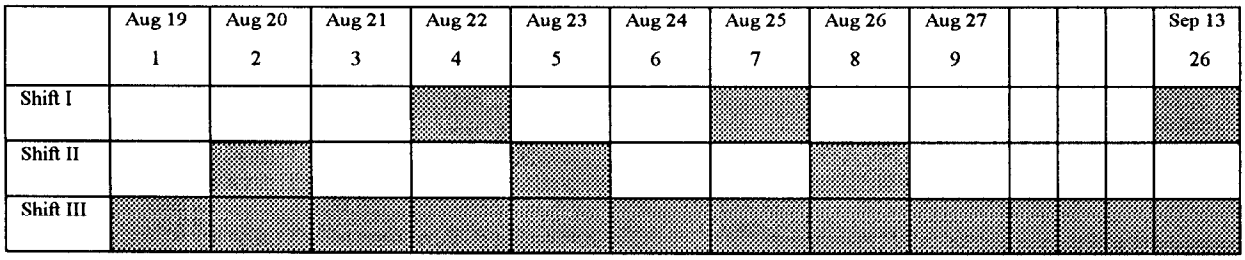

Figure 3.-Sampling schedule for the Nome River and Niukluk River counting towers, August 19 to September 6, 1995.

Total escapement for the entire counting period was estimated by summing an estimated escapement for each of five different sampling regimes. The five different sampling regimes were as follows:

Nome River	Niukluk River
July 27 to July 31, all shifts	July 29 to July 31, all shifts
August 1 to August 18, all shifts	August 1 to August 18, all shifts
August 19 to September 6, Shift I	August 19 to September 13, Shift I
August 19 to September 6, Shift II	August 19 to September 13, Shift II
August 19 to September 6, Shift III	August 19 to September 13, Shift III

A 24 h count (all possible shifts) was made on July 26 on the Nome River and on July 28 on the Niukluk River. Because this was a count of all possible shifts, and not an estimate needing expansion, this 24 h count was added to the total estimated escapement for each river. The estimated escapements for each sampling period and the associated variance for each period were

then summed to estimate the total escapement and associated variance for the entire sampled period.

AGE, SEX, AND LENGTH COMPOSITIONS

Coho salmon were sampled from the Niukluk River in order to estimate age, sex, and length compositions. Fish were examined on an opportunistic basis throughout the run. Samples were obtained by angling, inspection of sport catches, inspection of subsistence catches, or from examining carcasses of spent fish. The crew attempted to collect fish by beach seining, but were unsuccessful.

Each fish examined was measured (mid-eye to fork) to the nearest millimeter. Sex was determined by examining the external characteristics of the fish or by expressing sex products, and three scales were collected from each fish for aging. Scales were taken from the left side of the fish approximately two rows above the lateral line along a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Scarnecchia 1979). Scales were placed in coin envelopes upon which were recorded the species, location (river), date, sex, and length of the fish.

Proportions of coho salmon by ocean-age, sex, and 25 mm length category and the associated variances were estimated using:

$$\hat{p}_g = \frac{n_g}{n} \tag{1}$$

$$\hat{V}(\hat{p}_g) = \frac{\hat{p}_g(1-\hat{p}_g)}{n_g - 1} \tag{2}$$

where:

$\hat{p}_g$ = estimated proportion of coho salmon in age, sex or length class g;

n_g = number of coho salmon in age, sex or length class; and,

n = total number of coho salmon sampled.

ABUNDANCE ESTIMATION

Estimates of abundance were stratified by day for each sampling regime. Abundance estimates are considered a two-stage direct expansion within each sampling regime where the first stage is a 6 or 8 h shift within a day and the second stage is a 30 min counting period within a shift. Both stages are considered systematic sampling because neither the shift nor the 30 min counting period were chosen randomly.

The number of salmon which pass by the tower during each sampling regime and its variance were estimated by:

$$\hat{N} = D\bar{Y} \tag{3}$$

$$\mathrm{Var}(\hat{N}) = (1-f_1)D^2\frac{S_1^2}{d} + f_1 D^2 \sum_{i=1}^{d} M^2 (1-f_2)\frac{s_2^2}{d^2 m} \tag{4}$$

where:

D = number of 8 h shifts that could be sampled;

d = number of 8 h shifts sampled;

m = the number of 30 min counting periods sampled;

M = the total number of possible 30 min counting periods;

i = shift;

j = 30 min counting period;

y_{ij} = count of coho salmon during the j^{th} 30 min period during the i^{th} shift;

$\bar{y}_i$ = mean count of salmon across sampled 30 min periods within the i^{th} shift;

$$= \frac{\sum_{j=1}^{m} y_{ij}}{m};$$

Y_i = estimated passage of salmon during the i^{th} shift;

$$= M\bar{y}_i;$$

$\bar{Y}$ = estimated mean passage of salmon across sampled shifts;

$$= \frac{\sum_{i=1}^{d} Y_i}{d};$$

s_1^2 = estimated variance of total across shifts;

$$= \frac{\sum_{i=2}^{d} (Y_i - Y_{(i-1)})^2}{2(d-1)};$$

s_2^2 = estimated variance of total across 30 min counting periods within a shift;

$$= \frac{\sum_{j=2}^{m} (y_{ij} - y_{i(j-1)})^2}{2(m-1)};$$

f_1 = fraction of 8 h shifts sampled;

$$= \frac{d}{D}, \text{ and,}$$

f_2 = fraction of 30 min counting periods sampled;

$$= \frac{m}{M}.$$

For the sampling regime of Shift 1 of the period August 19 to September 6 (Nome River) or September 13 (Niukluk River), the estimated variance of the total across shifts was calculated using the following formula:

s_I^2 = estimated variance of total across shifts;

$$= \frac{\sum_{i=1}^{d} (Y_i - \overline{Y})^2}{(d-1)}.$$

SOLOMON RIVER COUNT

The Solomon River was surveyed by boat from the mouth of Shovel Creek to a point 0.8 km above the mouth of the river at Norton Sound on September 15, 1995 with two persons (boat operator and counter). The fish counter in the bow of the boat visually observed and counted coho salmon.

RESULTS AND DISCUSSION

NOME RIVER

Coho salmon were first observed on July 26. A total of 682 coho salmon were actually counted between July 25 and September 6. The estimated escapement of coho salmon past the counting tower for the period sampled was 1,712. The combined standard error of this estimate is 179, giving a 95% confidence interval for the escapement estimate of between 1,361 fish and 2,063 fish.

Although coho salmon were first observed moving past the counting tower on July 26, large numbers of fish were not observed during counted shifts until after August 8. The average for counted shifts for the period of July 26 to July 31 was 0.61 fish (Table 2). This average per counted shift rose to 10.00 fish during the period of August 1 to August 18. The average number of fish counted per sampled shift (for all counted shifts) rose again to 26.13 fish for the period of August 19 to September 6.

Comparisons of diel variation in salmon movement cannot easily be made between the three different time periods during which different sampling regimes were used, however, it is apparent from the counts made during the last two sampling periods (August 1 to August 18 and August 19 to September 6) that the majority of movement occurred between 2100 and 0500 hours (Appendices A3 and A4). During the period of August 19 to September 6, all possible 8 h counts were made during Shift III, but only every third 8 h count was made during Shifts I and II (Figure 3), so it is not possible to compare total numbers counted by shift during the period.

The average number of fish counted per shift during this period does show that most fish moved between 2100 and 0500 (shift average = 56.342), and that between 0600 and 1100, there was a net downstream movement of fish (shift average = -4.286). It should be noted that during this period of the run, all possible shifts of 2100 to 0500 were counted, while only 7 of 19 shifts from 0600 to 1100 were counted. Despite these differences in the relative confidence regarding these shift averages, the data strongly suggest that the majority of migration occurs during the night.

Since 1982 Alaska has been consolidated into one time zone and as a result the time in the Nome area is approximately three and one half hours ahead of solar time during the summer months. This means that the sun reaches its' zenith at approximately 1530 hours according to the clock instead of at noon. All times recorded and mentioned in this report are Alaska Daylight Savings Time, but the real hours of peak passage appear to be from 1800 - 0200 hours solar time.

Table 2.-Summary statistics for different sampling regimes from the Nome River coho salmon counting tower, 1995.

	Time Period of Sampling Regime				
	July 26-31	August 1-18	August 19 -September 6		
			Shift I	Shift II	Shift III
Average of sampled shifts	0.61	10	56.34	-4.29	26.33
Estimated escapement for period	12	540	1,070	-81	158
Standard Error	28.74	105.19	89.03	93.74	58.34
Total actually counted	4	130	537	-15	14
Add for 24 hour count	12				
Total estimated escapement, July 26 - September 6		1,712			
Sum of Standard Errors		178.91			
Total actually counted, July 26 - September 6		682			

This was the third year of the tower counting project on the Nome River. Tower counts were made from July 25 to August 28 during 1994 and from July 25 to August 15 during 1993. The estimated escapements of coho salmon for these two years for the periods sampled were 1,283 for 1994 and 4,349 for 1993 (Bue 1994, *In press*). These estimates were made using a different method of expansion than was used to generate the estimated escapement contained in this report, however, the estimate of escapement calculated in this report (1,712 fish) is quite similar to the estimated escapement (1,650 fish) calculated using the same count data as this report and using the same expansion methods that were used in 1993 and 1994 (Rob 1995).

The estimate of escapement for 1993 was for a period that ended well before the majority of the run had passed the counting tower (based on counts for 1994 and 1995). Because the estimates of escapement in 1995 (either total or up to the date of previous years estimates) were well below the levels of previous years, the Nome Subdistrict and the Pilgrim River were closed by emergency order to subsistence fishing effective on August 25. Sport fishing was also closed for coho salmon fishing in the marine and freshwater from and including Cripple Creek to the Solomon River and the Pilgrim River. Fish were not sampled for age and sex compositions on the Nome River during 1995 due to logistical problems and time constraints.

NIUKLUK RIVER

Coho salmon were first observed on July 28. The total number of coho salmon counted between July 28 and September 12 was 1,833. The combined estimated escapement of coho salmon for the period sampled was 4,633. The standard error of this estimate was 277, giving a 95% confidence interval for the escapement estimate of between 4,091 and 5,175 fish.

Coho salmon run timing in the Niukluk River in 1995 was similar to that on the Nome River. A very small proportion of the run was estimated to have passed the tower during July (Table 2), and about one fourth of the estimated run passed the tower between August 1 and August 18. The majority (approximately 74%) of the estimate resulted from tower counts during the period from August 19 to September 12. The average number of fish counted per shift was 5.33 during July, rose to 20.96 during the period from August 1 to August 18, and rose again (for all counted shifts) to 45.63 for the period from August 19 to September 12.

Daily counts per shift were relatively low up until August 8, when they started to increase (Appendix A1). As with the data from the Nome River, the differences in sampling regimes used during the three different sampling periods makes comparisons of diel patterns of migration between the three sampling periods impossible. Daily patterns of movement (within each sampling period) were similar to those seen on the Nome River. During both the period of August 1 to August 18 and from August 19 to September 12, counts within shifts tended to be highest from 2100 and 0500 hours (Appendicies A1 and A2). Most downstream movement was observed between the hours of 0600 and 1100.

During the period of August 19 to September 12, it is not possible to compare total numbers counted by shift, since all possible counts were made for Shift I, while only 8 of 25 possible shifts were counted for Shifts II and III. The average number of fish counted per shift for this period does show that most fish moved between 2100 and 0500 hours (shift average =108.40), fewer fish moved between 1300 and 2000 (shift average = 28.00), and that very few fish moved between 0600 and 1100 (shift average = 0.50). Again, taking into account the difference between Alaska Daylight Savings Time and solar time, the daily period of peak movement was from 1800 to 0200 solar time.

Table 3.- Summary statistics for different sampling regimes from the Niukluk River coho salmon counting tower, 1995.

	Time Period of Sampling Regime				
	July 28-31	August 1-18	August 19-September 12		
			Shift I	Shift II	Shift III
Average of sampled shifts	5.33	20.96	108.40	0.50	28.00
Estimated escapement for period	64	1132	2710	12	700
Standard Error of estimate	19.44	167.46	129.35	100	146.37
Total actually counted	24	283	1355	4	112
Add for 24 hour count	15				
Estimated escapement for July 26 - Sept 13		4,633			
Standard Error of combined estimate		276.72			
Total actually counted for period		1,833			

AGE, LENGTH, AND SEX COMPOSITIONS

Only 102 fish from the Niukluk River were sampled for age, sex, and length. It should be noted that these age, length, and sex ratios only relate to the sample, and not to the total escapement, since the sample was not taken in a completely random manner. Over half (54.9%) of the fish sampled for length were between 575 and 625 mm (Figure 4, Table 4). The average size for males (581.4 mm) was slightly greater than the average size for females (571.6 mm). Although the average size for males was slightly higher than for females, there were more males under 550 mm than females (Figure 5).

Sex composition was divided evenly between males and females. Of the 102 fish sampled, 50 were female and 52 were male. Of the 102 fish sampled, only 80 fish could be aged. Of the fish that were aged, 83.7% were age 2.1, 13.7% were age 1.1, and 2.6% were age 3.1. The number of fish sampled was not large enough to meet project objective criteria for length and age distribution ratios. While the sample size is small, it is large enough to meet the project objective for sex ratios.

Table 4.-Length, age, and sex compositions of coho salmon sampled from the Niukluk River, 1995.

Length Composition						
Length	n	Proportion	Standard Error of Proportion	95% Confidence Interval for Proportion		
500	4	0.04	0.02	0.00	to	0.08
525	6	0.06	0.02	0.01	to	0.11
550	12	0.12	0.03	0.05	to	0.18
575	22	0.22	0.04	0.13	to	0.30
600	34	0.33	0.05	0.24	to	0.42
625	19	0.18	0.04	0.11	to	0.26
650	5	0.05	0.02	0.01	to	0.09
Age Composition						
Age	Count	Proportion	Standard Error of Proportion	95% Confidence Interval for Proportion		
1.1	11	0.14	0.04	0.05	to	0.17
2.1	67	0.84	0.04	0.55	to	0.74
3.1	2	0.02	0.02	0.00	to	0.05
Sex Composition						
Sex	Count	Proportion	Standard Error of Proportion	95% Confidence Interval for Proportion		
male	52	0.51	0.05	0.41	to	0.61
female	50	0.49	0.05	0.39	to	0.59

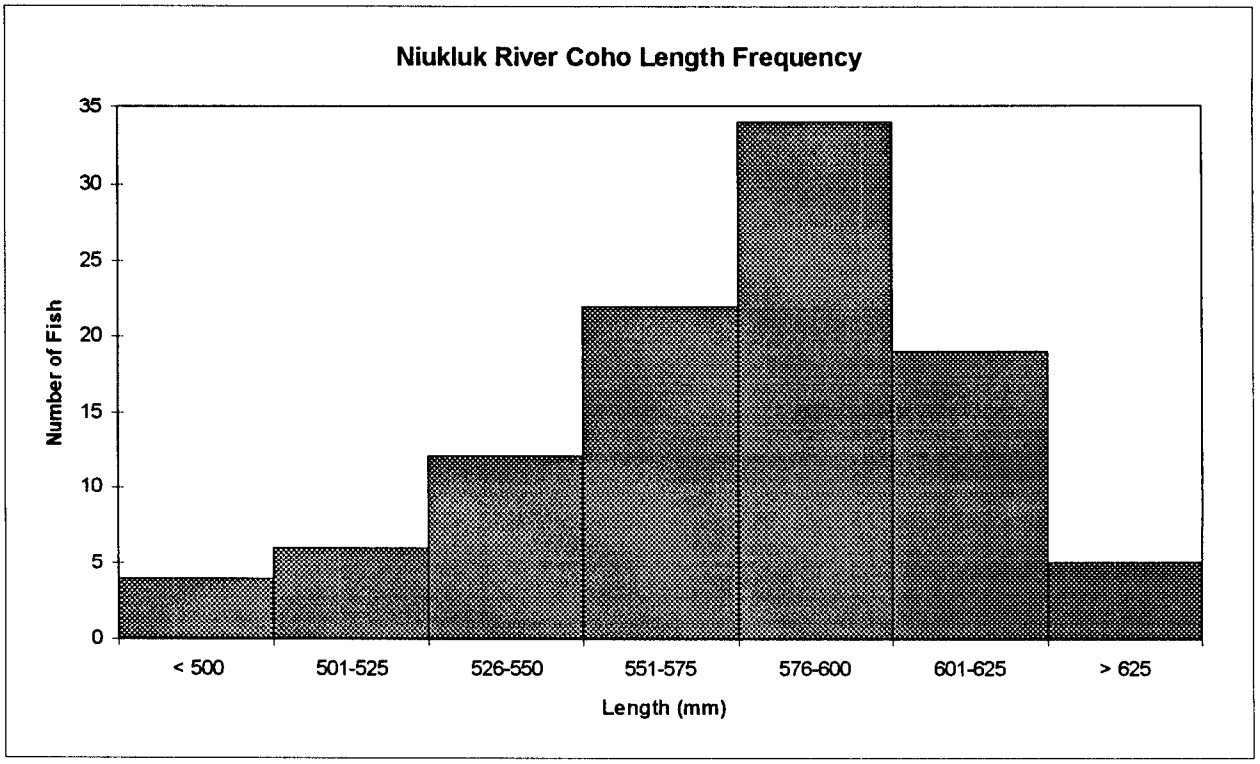

Figure 4.-Length distribution of coho salmon sampled from the Niukluk River, 1995.

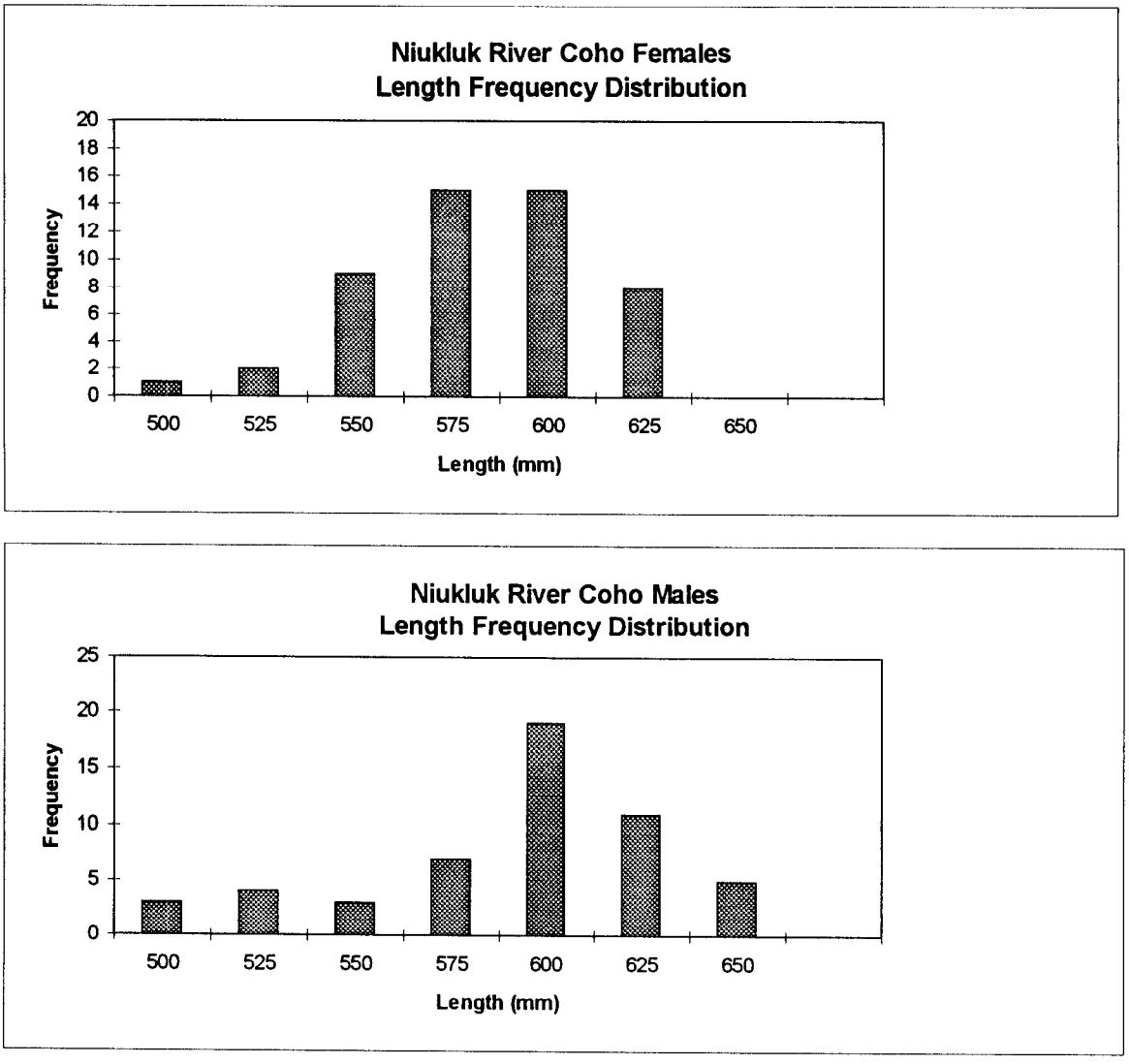

Figure 5.-Length distribution of male and female coho salmon sampled from the Niukluk River, 1995.

SOLOMON RIVER BOAT COUNT

A total of 250 coho salmon were counted on the Solomon River. Water conditions were conducive to observing fish. An aerial count of the river conducted on September 9 resulted in a count of 40 coho salmon. This is the first year that a boat count of coho salmon has been conducted on the Solomon River, so it is impossible to compare this years count with previous boat counts. Differences between boat and aerial counts are likely a result of more fish moving into the river between the time the aerial count was made (September 9) and the time the boat count was made (September 15), and due to the fact that aerial surveys commonly result in low fish counts.

RECOMMENDATIONS

The changes in sampling regime that were made during the counting process (resulting in three different sampling schedules for the period sampled) did not cause a major problem in determining the estimate of overall escapement. The use of three different sampling regimes did, however, make it difficult (if not impossible) to make comparisons of daily and seasonal run timing over the entire sampling period. In future studies of this type, it would be helpful to review any previous data on run timing, particularly on diel patterns of salmon migration, to use this knowledge to set up a sampling schedule that concentrates sampling effort on those periods of the day when salmon are most likely to move upstream, and to maintain that same sampling regime throughout the entire counting period. Coho salmon escapement in the Nome River is planned to be determined by the use of a weir during 1996, which should eliminate problems of sampling schedule changes, as well as ensure the ability to sample fish for length, age, and sex.

ACKNOWLEDGMENTS

I would like to thank Fred DeCicco and Peter Rob for assistance in writing this report, Mike Wallendorf for biometric assistance, Peggy Merritt for editorial help, and Jim Magdanz for the use of maps used in this report. I would also like to thank all of the field crew members who worked hard to collect the data needed for inseason management, and the assistance of the staff of the Nome office of CFMD, who helped with logistics. This study was funded in part by the Federal Aid in Sport Fish Restoration Program.

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APPENDIX A.
HOURLY COHO SALMON COUNTS

Appendix A1.- Hourly coho salmon migration past the Nome River counting tower, July 26 to August 18, 1995. Negative counts indicate fish movement down river.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
	Shaded areas indicate hours not counted																								
26-Jul	0	2	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
27-Jul	0	0	0	0	0	0							0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul	0	0	0	0	0	0							0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul	0	0	0	0	0	0							0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul	2	0	0	0	0	0							0	0	0	0	0	0	0	0	0	2	0	0	4
31-Jul	0	0	0	0	0	0																			0
1-Aug																	0	0	0	0	0	0	0	0	0
2-Aug									0	0	0	0	0	0	0	0									0
3-Aug	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
4-Aug									0	0	0	0	0	0	0	0									0
5-Aug	0	2	1	1	1	0	1	1									0	0	0	0	0	0	0	0	7
6-Aug									0	0	0	0	0	0	0	1									1
7-Aug	2	0	1	1	0	-1	0	0									1	0	0	0	0	1	1	0	6
8-Aug									1	0	0	0	0	0	0	0									1
9-Aug	2	8	4	1	6	1	1	0									0	2	-1	0	1	0	0	7	32
10-Aug									0	0	0	0	0	0	0	0									0
11-Aug	4	1	5	0	0	0	0	0									0	0	0	0	0	0	4	2	16
12-Aug									0	0	0	0	0	0	0	0									0
13-Aug	1	4	2	2	3	1	0	0									0	2	0	0	0	0	3	0	18
14-Aug									2	0	0	0	0	0	0	0									2
15-Aug	6	5	2	3	0	0	0	0									0	0	0	0	3	4	2	3	28
16-Aug									0	0	0	0	0	0	0	0									0
17-Aug	0	4	10	6	0	-1	-1	1									0	0	0	0	0	0	0	0	19
18-Aug									0	0	0	0	0	0	0	0									0
Total	17	26	29	20	10	0	1	2	3	0	0	0	0	0	0	1	1	4	-1	0	4	7	10	12	

Appendix A2.-Hourly coho salmon migration past the Nome River counting tower, August 19 to September 6, 1995. Negative counts indicate fish movement down river.

Shaded areas indicate hours not counted

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
19-Aug						1	2	4	0	0	0	0	0									2	0	0	9
20-Aug	5	11	5	1	-1									0	1	0	-2	0	0	0	1	0	0	0	21
21-Aug	0	7	3	0	-1																	1	1	13	24
22-Aug	9	25	22	30	0	-1	-1	0	0	0	0	1	1									0	11	0	97
23-Aug	3	7	20	5	4									0	0	0	0	0	0	0	0	5	0	0	44
24-Aug	18	16	4	6	5																	15	0	14	78
25-Aug	24	8	9	6	3	-4	0	-2	0	0	0	0	0									0	0	2	46
26-Aug	12	12	3	5	-2									0	0	0	0	8	1	0	0	0	0	0	39
27-Aug	2	9	-1	-1	0																	11	0	0	20
28-Aug	3	5	2	1	2	3	0	0	0	2	-1	0	2									4	0	0	23
29-Aug	0	0	2	1	1									0	0	0	0	0	0	0	0	1	0	0	5
30-Aug	1	6	1	0	8																	4	0	4	24
31-Aug	17	9	0	-1	2	-1	-1	0	0	0	0	0	0									35	0	0	60
1-Sep	2	0	-1	1	3									0	0	0	0	0	3	0	0	0	1	0	9
2-Sep	3	14	2	3	-7																	0	0	4	19
3-Sep	8	0	4	-1	-3	-7	0	-10	0	0	0	0	0									0	0	6	-3
4-Sep	0	3	1	4	0									0	-2	0	0	2	1	0	1	0	0	2	12
5-Sep	-1	-1	2	2	0																	0	0	0	2
6-Sep	1	3	0	1	5	-2	-2	1	0	0	0	0	0									0	0	0	7
Total	107	134	78	63	19	-11	-2	-7	0	2	-1	1	3	0	-1	0	-2	10	5	0	2	78	13	45	

Appendix A3.-Hourly coho salmon migration past the Niukluk River counting tower, July 28 to August 18, 1995. Negative counts indicate fish movement down river.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	100	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Daily Total
	Shaded areas indicate hours not counted																								
28-Jul	3	2	0	0	0	2	2	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	3	15
29-Jul	0	2	0	0	1	0							0	0	0	0	0	0	1	1	0	0	1	2	8
30-Jul	0	4	1	0	0	0							0	0	0	0	0	0	1	0	0	1	0	0	7
31-Jul	1	0	0	1	2	1							0	0	0	0	0	0	2	0	1	1	0	0	9
1-Aug	1	0	0	0	0	2	1	0									0	0	0	0	0	1	1	0	6
2-Aug									0	0	0	0	0	2	0	0									2
3-Aug	0	0	0	0	0	0	1	0									0	1	1	1	1	0	1	4	10
4-Aug									0	0	0	1	0	0	0	0									1
5-Aug	0	3	1	0	1	0	-1	1									-1	1	2	0	0	0	1	0	8
6-Aug									0	0	0	1	0	0	1	0									2
7-Aug	3	2	0	0	0	2	0	1									1	0	0	1	0	3	4	4	21
8-Aug									-1	0	1	0	0	0	0	1									1
9-Aug	1	2	1	1	0	-1	3	1									0	1	0	1	0	1	4	8	23
10-Aug									0	0	0	0	0	1	1	0									2
11-Aug	3	6	2	0	2	1	-1	0									0	1	-1	2	2	4	4	-1	24
12-Aug									0	0	0	-1	0	0	3	4									6
13-Aug	23	13	8	5	5	4	1	-3									1	1	3	3	1	5	1	2	73
14-Aug									-1	-2	-1	1	0	-2	4	2									1
15-Aug	11	9	8	2	1	2	-1	1									1	1	2	3	2	0	5	1	48
16-Aug									0	-1	2	0	0	1	1	0									3
17-Aug	13	12	8	9	4	2	-4	-6									0	0	4	0	0	2	5	0	49
18-Aug									0	-2	1	0	2	1	0	1									3
Total	59	55	29	18	16	15	1	-5	-2	-5	3	2	2	3	10	8	3	6	15	13	7	18	28	23	

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Appendix A4.-Hourly coho salmon migration past the Niukluk River counting tower, August 19 to Sept. 12, 1995. Negative counts indicate fish movement down river.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	100	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Daily Total
	Shaded areas indicate hours not counted																								
19-Aug	18	13	6	4	1	3	-1	-2	0	0	0	0	0									11	6	16	75
20-Aug	17	23	17	16	1									7	3	-1	5	-1	2	1	4	15	10	1	120
21-Aug	27	17	13	6	2																	4	9	49	127
22-Aug	27	44	17	7	13	5	6	2	-2	0	0	-1	1									0	23	26	168
23-Aug	46	16	14	4	5									0	0	2	1	-1	1	3	3	1	4	24	123
24-Aug	19	15	4	8	4																	0	10	32	92
25-Aug	15	13	11	5	0	2	-4	1	1	0	-2	0	0									2	1	12	57
26-Aug	11	24	11	10	7									0	0	-1	2	0	1	13	0	3	1	11	93
27-Aug	19	11	14	4	8																	0	8	17	81
28-Aug	12	2	9	1	5	3	-1	0	0	-1	1	1	1									4	-8	9	38
29-Aug	6	4	5	7	1									1	0	0	1	5	0	2	-2	3	4	5	42
30-Aug	3	2	4	2	2																	8	8	30	59
31-Aug	22	9	17	9	-3	-2	-5	-3	-1	2	-2	4	1									2	6	6	62
1-Sep	7	2	1	3	4									4	0	1	0	3	5	2	8	0	2	12	54
2-Sep	7	6	6	-2	0																	0	0	23	40
3-Sep	11	3	7	1	3	-4	-7	1	0	-1	3	0	0									2	-1	19	37
4-Sep	10	0	6	1	-2									1	1	2	1	-1	-1	2	0	4	0	14	38
5-Sep	7	5	-1	1	8																	0	0	5	25
6-Sep	2	1	-2	3	-5	-1	2	2	0	0	0	0	0									-3	0	2	1
7-Sep	-1	8	11	7	3									2	0	1	2	1	0	15	0	1	2	16	68
8-Sep	2	3	-1	2	1																	3	8	6	24
9-Sep	-4	4	1	1	-3	-1	-1	3	-1	3	-1	0	0									2	2	8	13
10-Sep	2	0	-2	0	0									0	1	0	5	1	4	3	-2	3	9	2	26
11-Sep	5	2	3	1	0																	0	2	2	15
12-Sep	-1	-1	-1	-1	-3																	0	0	0	-7
Total	289	226	170	100	52	5	-11	4	-3	3	-1	4	3	15	5	4	17	7	12	41	11	65	106	347	